Biofuels for Your State

Helping the Economy and the Environment

Biofuels For Sustainable Transportation

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Biofuels are liquid transportation fuels made from plant matter instead of petroleum. Bioethanol and biodiesel—the primary biofuels today—can substitute for gasoline and diesel or be blended with them to reduce toxic air emissions. Using biofuels also reduces greenhouse gas buildup, dependence on imported oil, and trade deficits, while supporting local agriculture and rural economies.

Ethanol—Solving Local Problems

Dependent upon foreign sources, complex regulations, and synthetic chemicals, the supply and content of your gasoline sometimes seems frustratingly out of our control. But there is a safe, environmentally friendly automotive fuel that can be grown and produced locally—ethanol. Expected to be the fuel for early automobiles, there when an anti-knock replacement was needed for poisonous lead or embargoes reduced oil supplies, ethanol has a proven track record helping to solve local problems.

For Carbon Monoxide: The Clean Air Act Amendments of 1990 mandate that regions with high levels of carbon monoxide (CO) must use oxygenated fuels during the winter. Sixteen regions in ten states (AK, AZ, CA, CO, MT, NV, OR, TX, UT, WA) are currently subject to these regulations. All of the regions but Los Angeles use 7.7%-10% ethanol blends with their gasoline to comply. Because ethanol contains oxygen—gasoline has none—the blended fuel combusts more completely, particularly in older cars or cars with higher mileage, reducing carbon monoxide formation.

For Smog/Ozone: The Clean Air Act Amendments also direct regions severely failing to meet standards for ground-level ozone—the main pollutant we usually associate with smog—(or voluntarily participating in the program) to use "reformulated gasoline" (RFG). Ozone formation is a complex process triggered by ultraviolet radiation, but the chief components of the reaction are hydrocarbons, carbon monoxide, and nitrogen oxides. RFG is formulated to minimize this reaction, principally by

Continued inside

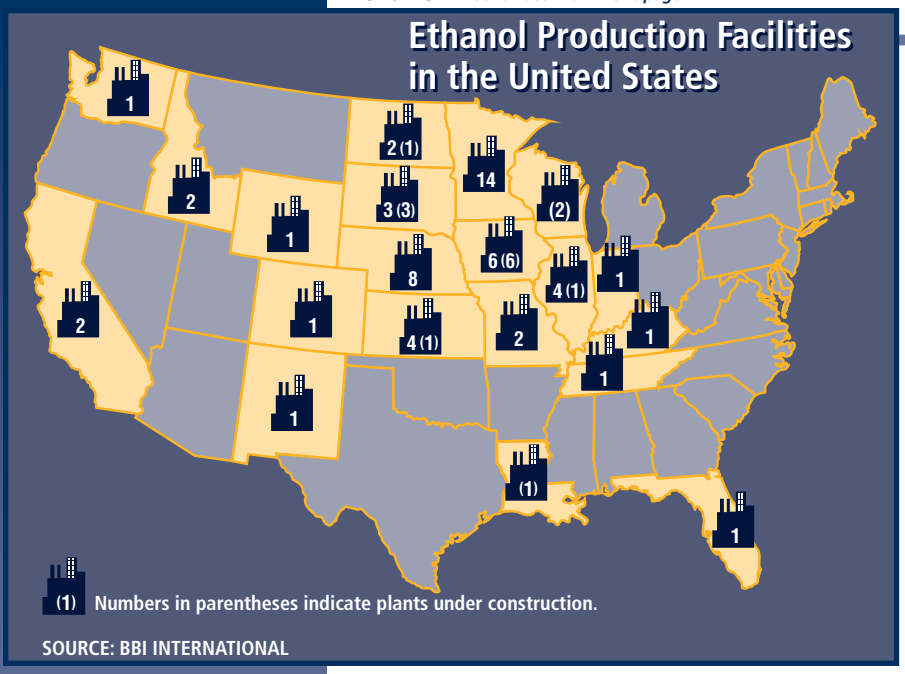
Biodiesel—an Easy Way to Reduce a Dirty Problem

Driving behind an accelerating truck or bus provides ample visual evidence that diesel engines pollute. And, the particulate matter indicated by that black smoke is not just ugly. Determined by the California Air Resources Board to be a toxic air contaminant, along with other pollutants from diesel exhaust, it poses a serious health threat. A domestic, renewable fuel manufactured from animal fats, vegetable oils, or recycled cooking grease, biodiesel provides an easy way to reduce the hazard of those diesel emissions while contributing to domestic energy security.

For All Diesels: (including trucks, buses, electric generators, ships and boats, off-road and farm equipment, and other uses): Biodiesel can be used straight (B100) or as a blend, most often 20% (B20) with diesel #2 (diesel #1 in winter). Because it gels at higher temperatures than petroleum diesel, B100 requires special management in cold climates. Also, rubber seals, gaskets, and hoses made before 1994 should be replaced when using B100. B20 poses no cold climate problems and users should just increase inspection to catch possible problems with rubber fuel system parts. Check with the engine manufacturer, though, as to whether warranties include biodiesel use. Because of biodiesel's superior lubricity, as little as 1-2% is sometimes added to reduce engine wear. Biodiesel contains slightly less energy than petroleum diesel, so fuel economy may fall about 7% with B100 or 1-2% with B20.

For Air Quality: Because it is oxygenated, biodiesel use dramatically reduces toxic air emissions. B100 can cut carbon monoxide,

Continued on back page



including oxygenates to reduce the amount of unburned hydrocarbons or volatile organic compounds (VOCs) emitted from the tailpipe. Because 25 regions in 17 states (CA, CT, DC, DE, IL, KY, MA, MD, MI, NH, NJ, NY, PA, RI, TX, VA, WI) are currently participating in this program, about 30% of the gasoline sold in the United States is RFG. The type of oxygenate included in the RFG varies by manufacturer and region, but as of July 2001, about 87% of U.S. RFG contained methyl tertiary butyl ether (MTBE), a petroleum-derived oxygenate, rather than ethanol. Although ethanol is widely used in the Midwest, fuel blenders elsewhere generally cite cost, ease of pipeline shipment, and lower volatility for MTBE preference.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MTBE, however, has extensively contaminated groundwater and many states are moving to ban its use. Already, as of July 2001, Arizona, California, Colorado, Connecticut, Illinois, Iowa, Kansas, Maine, Michigan, Minnesota, Nebraska, New York, South Dakota, and Washington have directed phase out of its use. Essentially nontoxic and biodegradable, ethanol does not pose a significant water pollution hazard and can easily substitute for MTBE. A concern rasied about ethanol as an oxygenate is that mixing ethanol with gasoline increases volatility of the mixture, allowing more VOCs to escape from the fuel system, offsetting the benefit of reduced tailpipe VOC emissions. The U.S. Environmental Protection Agency, however, recently provided a VOC credit for ethanol-blended RFG to recognize that its CO benefits outweigh the disadvantages of increased VOC emissions. (CO contributes as much as 20% of reactivity of ozone forming emissions.)

Whether located in an air quality non-attainment area or not, fuel retailers may blend ethanol with gasoline to increase octane (a measure of the fuel's ability to prevent "knocking"). A 10% blend of ethanol increases the gasoline's octane rating by 3 points. Of the legal additive options (leaded gasoline, which was used for many years, has now been banned), including MTBE, various aromatics, and ethanol, ethanol is clearly the best choice for the environment.

For Alternative Fuels Requirements: The Energy Policy Act of 1992 (EPAct) requires state and federal government fleets to purchase alternative fuel vehicles for three-quarters of their new light-duty vehicle purchases. Additionally, alternative fuel provider fleets covered by EPAct are required to purchase alternative fuel vehicles for 90% of their new vehicle purchases. (Local government and private fleets are not covered by this rule, but the U.S. Department of Energy has the authority to include them at a future date.)

Ethanol is an excellent alternative fuel (the standard is E85, a blend of 85% ethanol and 15% gasoline). Flexible-fuel vehicles designed to use E85 or other gasoline mixtures include modified oxygen sensors and different seals in the fuel system. E85 flex-fuel vehicles qualify as alternative fuel vehicles and Daimler-Chrysler, Ford, and General Motors all offer several models designed to use E85 or gasoline for the same price as gasoline-only models. Today, 92 state and alternative fuel provider fleets use E85 flex-fuel vehicles to help them meet their EPAct requirements. As of July 2001, 129 retailers in 18 states (AZ, CO, ID, IL, IN, IA, KS, KY, MI, MN, MO, MT, NE, NM, ND, SD, VA, WI) offered E85 at public service stations. Because ethanol has less energy per gallon than gasoline, E85 vehicles need larger fuel tanks to keep the same range.

Ethanol—Using Local Resources

From Corn: In the United States, ethanol, also known as grain alcohol, is made from the starch in kernels of field corn. (Field corn is otherwise predominantly used as animal feed; current ethanol production uses only 7% of the feed corn crop). Modern fuel ethanol technology is highly sophisticated and efficient, and the process is similar to making alcoholic beverages. Starch is converted into sugars, the sugars are fermented to a "beer," and then the beer is distilled to make pure ethanol.

Of U.S. corn ethanol production, about half is in wet-mill plants and half is in dry-mill plants. The former are typically large operations that

produce ethanol along with a slate of food products such as corn sweeteners, corn syrup, corn oil, and gluten feed. The latter are typically smaller facilities that produce ethanol as their primary product and a high-protein animal feed known as distillers dried grains as a co-product. The dry-mill plants are typically located in rural communities and often farmer-owned, which make them an excellent way to develop the local economy. In 2000, 7 wet-mill and 51 dry-mill plants produced more than 1.6 billion gallons of ethanol. While ethanol accounts for about 1.5% of automotive fuel use in the United States, it is blended in one of out every eight gallons of gasoline for pollution reduction.

Ethanol made from corn is slightly more expensive than gasoline. To encourage ethanol use, however, the federal government exempts 5.3 cents per gallon of 10% ethanol blend (53 cents per gallon of ethanol) of the 18.3 cents per gallon federal fuel excise tax. In effect since 1979, this exemption makes ethanol competitive for fuel additive use. Several states also provide additional incentives. The federal subsidy, however, is more than offset by reduced agricultural price support payments (2000 saw the lowest corn prices in 20 years), and increased employment taxes for an estimated net taxpayer savings of about $3.6 billion per year. The U.S. Department of Agriculture credits the sale of corn for ethanol production—about 600 million bushels per year—with increasing corn prices by 25 to 30 cents per bushel. (The typical price range of field corn is $1.80 to $2.30 per bushel.)

From Other Starch or Sugar: Even states with a small corn crop can benefit from building ethanol plants. Conventional ethanol technology can process any starch or sugar source. While corn certainly predominates, U.S. plants are currently making ethanol from barley, milo, wheat starch, potato waste, cheese whey, and brewery and beverage waste.

From Cellulose and Hemicellulose: Starches and sugars constitute only a small portion of plant matter. The bulk of most plants consists of cellulose, hemicellulose, and lignin. Cellulose and hemicellulose, though, are made of chains of sugars. Advanced bioethanol technology can break these chains down into their component sugars, and then ferment them to ethanol. This makes it possible to produce ethanol from virtually any biomass material. In the near-term, ethanol will probably be made from low- or negative-cost "opportunity" feedstocks such as municipal waste, wood processing waste, sugarcane bagasse, rice hulls, or rice straw. In the mid-term, ethanol sources will include agricultural and forestry residues such as corn stover—a huge potential source—or wood chips. In the long-term, farmers may grow dedicated energy crops, such as switchgrass or fast-growing trees, just for fuel production.

Because it requires sophisticated conversion technology, making ethanol from cellulosic biomass is currently more expensive than making it from corn grain. The feedstocks would be inexpensive, however, so experts expect equal or lower costs in the long run. Advanced bioethanol technology will supplement rather than replace corn-grain ethanol by greatly expanding the potential feedstock supply and making ethanol production an option for all of the country. The U.S. Department of Energy National Biofuels Program is spearheading the effort to improve advanced bioethanol technology and expects to have commercial demonstration plants in operation by 2005 using agricultural residues. ■

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STATE ETHANOL INCENTIVES (AS OF JULY 2001)

STATE	STATE EXCISE TAX EXEMPTION*	STATE PRODUCER CREDITS
Alaska	$.06 per gallon tax exemption $.08 if from cellulose	No producer credit
Connecticut	$.01 per gallon tax exemption	No producer credit
Hawaii	4% tax exemption	No producer credit
Idaho	Average exemption is $.023 per gallon based on amount blended (up to 10%)	No producer credit
Illinois	2% sales tax exemption—average exemption is $.01 to $.015 per gallon	No producer credit
Iowa	$.01 tax exemption	No producer credit
Kansas	No tax exemption	$.075 per gallon for new capacity; $.05 per gallon for existing capacity
Minnesota	No tax exemption for 10% blend; $.058 total tax exemption for E85	$.20 per gallon producer credit
Missouri	No tax exemption	$.20 per gallon for the first 12.5 million gallons; $.05 per gallon for the next 12.5 million
Montana	No tax exemption	$.30 per gallon producer credit
Nebraska	No tax exemption	$.18 per gallon for new capacity; $.075 per gallon for expanded capacity
North Dakota	No tax exemption	$.40 per gallon producer credit
Oklahoma	No tax exemption	$.20 tax credit per gallon of ethanol produced
South Dakota	$.02 tax exemption	$.20 per gallon producer credit
Wisconsin	No tax exemption	$.20 per gallon production credit
Wyoming	No tax exemption	$.40 per gallon producer credit

*Exemption per gallon of 10% blended fuel

SOURCE: BBI INTERNATIONAL

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Biodiesel—*Continued from front page*

hydrocarbons, particulates, and other pollutant emissions in half while reducing the cancer-risk contribution of diesel by about 90%. Emission reductions with B20 are roughly proportional. Biodiesel will even reduce the smelly oily smoke that makes it so frustrating to get caught behind a truck or bus.

For Fleets: Although EPAct's alternative fuel vehicle purchase requirements for state and federal fleets do not apply to heavy vehicles, fleets can receive credit for using biodiesel (2,250 gallons of B20 equals one alternative fuel vehicle purchase) and fleet managers may use those credits for up to half of their alternative-fuel light-duty vehicle purchases. All other alternative fuels require expensive purchases for new vehicles, so using B100 or B20 can save fleets a lot of money—while substantially reducing pollution. For city bus and other highly visible fleets, switching to biodiesel is an easy way to make an important statement of concern about air quality and customer health.

BIODIESEL REDUCES EMISSIONS

EMISSION	B100	B20
Carbon monoxide	-43.2%	-12.6%
Hydrocarbons	-56.3%	-11.0%
Particulates	-55.4%	-18.0%
Nitrogen oxides	+5.8%	+1.2%
Air toxics	-60%-90%	-12%-20%
Mutagenicity	-80%-90%	-20%

Biodiesel—Easily Produced

From Fats or Oils: Fatty acid methyl ester, commonly known as biodiesel, is made by bonding alcohol (commonly methanol) to oils or fats (even animal fats or used cooking oil). The process is relatively routine, but must consistently achieve prescribed standards adopted by the American Society for Testing and Materials to minimize the risk of damaging expensive diesel engines.

Half of U.S. biodiesel production capacity is designed for soybean oil, and half for recycled restaurant cooking oil, earning biodiesel a reputation for having a pleasant french-fry smell. [In Europe most biodiesel is made from rapeseed (canola) oil.] Because of incentives from a U.S. Department of Agriculture program supporting commodity purchases for increased biofuel production, 2001 U.S. biodiesel production was predominantly from soybean oil, but once the effect of the commodity program is over, the two main sources will likely again roughly balance. Both soybean oil and recycled restaurant cooking oil are currently in surplus and biodiesel production uses only a small portion of each, so there is no resource constraint.

From a Growing Industry: Biodiesel popularity is growing rapidly, with U.S. sales increasing from about 7 million gallons in 2000 to more than 20 million gallons in 2001. 2001 production was near capacity for the seven current dedicated biodiesel producers [located in HI, IA (2), KY, FL, NV, and IL], but most of these producers are expanding and at least another dozen facilities are in the planning stages. Also, the detergent and fatty acid industries, which supply methyl esters to the biodiesel industry and can provide extra supplies when demand grows quickly, could provide another 30-50 million gallons of capacity, if needed to meet demand. Biodiesel is generally more expensive than diesel fuel, but B20 typically costs only 8 to 20 cents more than regular diesel. Although usually used by centrally fueled fleets, as of July 2001, biodiesel was available at retail service stations in at least seven states (AZ, CA, HI, ME, MN, NV, SC). ■

RESOURCES FOR MORE INFORMATION

On biofuels generally and advanced bioethanol technology for producing ethanol from lignocellulosic biomass:
the U.S. Department of Energy Biofuels Program—www.ott.doe.gov/biofuels/

On ethanol production and relevant policy:
the Renewable Fuels Association, a trade association for the ethanol production industry—www.ethanolrfa.org

On biodiesel production and relevant policy:
the National Biodiesel Board, a trade association for the biodiesel production industry—www.biodiesel.org

On E85 vehicles and suppliers:
the National Ethanol Vehicle Coalition—www.e85fuel.com

On alternative fuels use and fueling stations:
the Alternative Fuels Data Center—www.afdc.doe.gov
the Fleet Buyers Guide—www.fleets.doe.gov
and the National Alternative Fuels Hotline—800-423-1363

On EPAct fleet information and regulations:
the U.S. Department of Energy Office of Transportation Technologies—www.ott.doe.gov/epact

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